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## Substitution of Stable Isotopes in *Chlorella*

Replacement of the biologically important isotopes in the alga *Chlorella* by the corresponding heavier stable isotopes has been reported (1). Marked cytological changes resulted.

Compounds of the elements carbon, hydrogen, oxygen, and nitrogen constitute more than 99% of the mass of protoplasm. It was felt that, although hydrogen might be expected to show the greatest isotope effects of any element, isotope effects associated with replacement of the other important components of protoplasm, by their heavier isotopes, also might be expected to be significant, especially if multiple substitutions were attempted. Thus were investigated the effects of cumulative replacement of hydrogen, carbon, oxygen, and nitrogen by their heavier stable isotopes  $H^2$ ,  $C^{13}$ ,  $O^{18}$ , and  $N^{15}$ .

The organism chosen for the study was the common green alga *Chlorella vulgaris* which can be readily adapted to growth in 99.7%  $D_2O$  under autotrophic conditions. Thus one could investigate the introduction of  $C^{13}$ ,  $N^{15}$ , and  $O^{18}$  into the organism and examine the morphological and cytological effects of substitution or essentially complete isotopic replacement.

Results indicate that this progressive isotopic substitution produces increasingly greater deviations from the normal size of cells, the more highly substituted cells being much larger than ordinary cells. Staining techniques also revealed that isotopic substitution changes the quantity and distribution of such cellular components as nucleic acids, carbohydrates, and proteins.

The demonstrated usefulness of isotopically altered organisms (and compounds extracted from them) for electron paramagnetic resonance and nuclear magnetic resonance studies increases interest in the study of such isotopically permuted organisms.

### Reference:

1. R. A. Uphaus, E. Flaumenhaft, J. J. Katz, *Biochim. Biophys. Acta* **141**, 625 (1967).

### Notes:

1. This information may interest such organizations as hospitals, cancer societies, pharmaceutical companies, and air-pollution agencies.
2. Inquiries may be directed to:

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### Patent status:

Inquiries concerning rights for commercial use of this innovation may be made to:

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